News Releases

Keeping Cool with Science

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Graphic courtesy of the Naval Health Research Center

On land or at sea, from scorching deserts to sweltering engineering spaces, military operations often require service members to work in environments that make heat safety a constant concern. When factoring in individual activity and fitness levels, gear, equipment, and clothing, body heat isn't the only thing building up—the potential for heat injuries rises, too.

Over the last 28 years, I've been conducting thermal research at the Naval Health Research Center (NHRC) to develop strategies that reduce or prevent heat injuries and keep our troops healthy and mission-ready.

When a unit loses personnel due to heat injuries, reduced manning can make it difficult to meet operational requirements and negatively impact mission success. In 2013 alone, there were 324 cases of heat stroke and just over 1,700 other heat injuries among active duty service members. That is over 2,000 warfighters who were unable to report for duty, either temporarily or permanently, and support their unit's mission.

To optimize the operational readiness of our warfighters, Navy Medicine has been proactive in conducting medical research to reduce heat injuries and optimize the safety of military personnel working in hot conditions for decades. I conducted my first thermal physiology study in 1989 and, ever since, environmental physiology has been the primary focus of my research. Over the years, my team and I have conducted several studies to prevent service members from incurring heat injuries, to include:

- Evaluating individual thermoregulatory capacity
- Identifying safe heat exposure limits
- Investigating the use of microclimate cooling (ice vests, water cooled vests)
- Developing advanced technologies to monitor environmental conditions and provide current time heat exposure guidance

Making an Impact

The Automated Heat Stress System (AHSS) was developed at NHRC in 1997 by a collaborative effort with my research team and has had tremendous impact on operational forces by improving heat stress monitoring. The AHSS provides a very accurate measure of thermal conditions in any given environment by factoring in air temperature, radiant or black globe temperature, and relative humidity. The AHSS then automatically calculates the Physiological Heat Exposure

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NAMRU-Dayton hosts Aerospace Medicine Research Alignment and Collaboration

Peruvian Navy Surgeon General and Other Distinguished Guests Visit Naval Medical Research Center

Military Sealift Deputy Commander Visits Navy Lab in Dayton

Two Naval Medical Research Center Corpsmen Selected for Medical Degree Prepatory Program

NMRC Summer Interns Arrive, All Ready to Research

NAMRU-SA Researchers Working on Laser Therapy Project to Improve Treatment of Multi-Drug Resistant Wound Infections

R&D Chronicles: Remembering NAMRU-5, the Navy's Medical Laboratory in Ethiopia, 1965-1977

Defense Health Agency to Assume Oversight of DoD HIV/AIDS Prevention Program

NAMRU-SA Research Dentist Competes for IRONMAN "All World Athlete" Status

Navy Core Values and Grit in Action – A Trek to Mt. Everest Base Camp

NMRC Participates in Second Biennial Department of Defense Lab Day

R&D Chronicles: Give Me (Fallout) Shelter: A Look Back at the Navy's Protective Shelter Study

Naval Medical Research Center Holds Retirement Ceremony for Executive Officer

NMRC Participation in the NATO COMEDS Visit to the National Capital Region

Osseointegration Offers Amputees a Revolutionary New Option in Prosthesis

Limits (PHEL Curves), which provides guidance on the amount of time personnel may safely remain in a particular workspace, known as "stay time."

Before the AHSS, shipboard measures to prevent heat injuries required Sailors to walk through each workspace that could produce heat stress conditions and take manual temperature readings. On a typical Navy destroyer, this could take three hours. Now, with a push of a button, the AHSS delivers a printout within seconds of all heat stress conditions for affected workspaces and provides the PHEL Curves.

The first AHSS was installed on a destroyer in 1997 and, since 2003, it has been incorporated in the construction plans for each new destroyer. It is now used on more than 60 Navy ships.

In 2002, the AHSS was implemented ashore to help reduce heat injuries by providing flag-condition guidance. The flags—which are green, yellow, red, and black—determine what physical activity is allowable and clothing restrictions while performing physical activity. As it does aboard ship, the AHSS automatically monitors and calculates conditions. Currently, AHSS ashore has been installed at approximately 50 shore commands around the world.

Research Underway

Building on our past work with the AHSS, NHRC is currently working on a project to revise the PHEL Curves, which were developed in the 1960s and have not changed since. Routine shipboard work has changed dramatically over the past 57 years with adoption of smart technology and work practices, which could impact current guidance for stay times.

In the near future, my thermal team will be deploying with several ships to measure the body temperature, heart rate, and metabolic activity of Sailors as they perform their duties aboard ship in an operational environment. After we analyze all the data we collect, we will propose modifications to current PHEL Curve guidance.

Factoring in Success

Two factors that have contributed to our research success are the strategic location of NHRC in one of the largest areas of fleet concentration and our environmental chamber.

We are located in San Diego, California, just a short distance from two naval hospitals, several Marine Corps bases, a recruit training command, and the U.S. Navy's Third Fleet. Proximity to nearly every type of operational unit and environment in our armed forces ensures we are aligning our research with the requirements of our operational forces.

Our environmental chamber, one of six configured for human use research within the Department of Defense (DoD), allows us to recreate environmental conditions, such as you would find on a ship, recreate anticipated workloads, and conduct research in a controlled environment. We can then take our results back to the fleet where they can be implemented in an operational setting. We acquired our first environmental chamber in 1990 in support of research for Operation Desert Shield/Storm and conditions our troops would encounter in a hot, arid environment. In 2010, we installed our current chamber, which 20-feet wide by 29-feet long and is the newest chamber in DoD. Its capabilities include:

- Temperature range: -23°F to 130°F
- Humidity range: 5-95%
- Wind speed/Laminar air flow range: 0.5-7 mph
- Two, 4-person treadmills (5-foot wide by 9-foot long)
- Laser rifle shooting system with reaction time capability

The research we do at NHRC contributes to the health and safety of our warfighters on a daily basis. While I have never worn a uniform, I've had the privilege of being a Navy civilian for nearly three decades and I take great pride in knowing that I've made a difference.

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SIDEBAR:

Heat Injuries

Military personnel can be prone to heat injuries for many reasons, which makes it important to know about the different types of heat injuries that can occur. They include:

Navy Medicine West Visits NHRC to Discuss Readiness Through Research

Chasing a Passion: Naval Medical Research Center Researcher Participates in Annual Boston Marathon

Naval Medical R&D Enterprise Holds Commander's Conference

NAMRU-D Showcases Scientific Skill to Navy Medicine West Leadership

Heat rash is a skin irritation caused by heat stress exposure. It usually appears as red bumps on the neck, groin area or under the arms.

Heat syncope (fainting) is most likely to occur when unacclimated personnel are first exposed to heat stress or by personnel standing still in the heat (for example, standing in formation).

Heat cramps are painful cramps, usually affecting the extremities and abdomen. They primarily occur in individuals performing vigorous physical exercise in heat stress conditions.

Heat exhaustion is a more serious heat stress exposure injury. Heat exhaustion may be related to either dehydration or salt depletion. Personnel usually require medical treatment to ensure they are properly recovering and re-hydrating.

Heat stroke results when the body's ability to maintain optimum core body temperature fails. Heat stroke is a medical emergency and can be lethal or have life-long lingering after effects.